

REVISION OF TOCOYENA (RUBIACEAE: GARDENIEAE) FROM
THE STATES OF GOIÁS AND TOCANTINS AND A NEW SPECIES
ENDEMIC TO WHITE-SAND AREAS IN THE BRAZILIAN CERRADO

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ABSTRACT

During the preparation of the Rubiaceae treatment for the *Flora de Goiás e Tocantins*, detailed field and herbarium observations were made on the species of *Tocoyena* Aubl. (Rubiaceae, Gardenieae) occurring in this area, and are presented here. Also, some recent collections of *Tocoyena* from white-sand areas in the states of Goiás and Tocantins attracted my attention to the vegetation of these areas. Although many studies are available on the vegetation of white sand areas of the Amazon Basin (known in Brazil as “campinas” or “campinaranas”), very little is known about the quartzitic white sand areas of the Cerrado Biome. A short discussion about these areas is presented, a new endemic species of *Tocoyena* is described and illustrated, and a call for urgent programs for the conservation of these areas is launched. A key to the species of *Tocoyena* encountered in the states of Goiás and Tocantins is also included.

KEY WORDS: *Tocoyena*, Gardenieae, Rubiaceae, Goiás, Tocantins, white sands, Cerrado, Brazil, conservation

RESUMO

Durante a preparação do tratado das Rubiaceae para a *Flora de Goiás e Tocantins*, foram efetuadas detalhadas observações de campo e de amostras de herbário sobre as espécies de *Tocoyena* Aubl. (Rubiaceae, Gardenieae) presentes nestes estados e são aqui apresentadas. Também, algumas coletas recentes de *Tocoyena* provenientes de áreas de areias brancas nos Estados de Goiás e Tocantins atraíram a minha atenção sobre estas localidades. Embora existam muitos estudos sobre áreas de areia branca na Bacia Amazônica (conhecidas no Brasil como “campinas” ou “campinaranas”), se sabe muito pouco sobre as áreas de areias brancas quartzíticas no Bioma Cerrado. Uma curta discussão sobre estas áreas é apresentada, uma nova espécie endêmica de *Tocoyena* é descrita e ilustrada, e um apelo por um urgente programa de conservação destas áreas é aqui lançado. Uma chave para as espécies de *Tocoyena* encontradas nos Estados de Goiás e Tocantins é também incluída.

PALAVRAS CHAVE: *Tocoyena*, Gardenieae, Rubiaceae, Goiás, Tocantins, areias brancas, Cerrado, Brazil, conservação

During the preparation of the Rubiaceae treatment for the *Flora de Goiás e Tocantins*, detailed field and herbarium observations with taxonomic implications were made on the species of *Tocoyena* Aubl. (Rubiaceae, Gardenieae) occurring in this area. *Tocoyena* is a genus of about 25 species with Neotropical distribution, represented by subshrubs, shrubs and trees. The genus was divided into two groups by Schumann (1891) based on the shape of the corolla lobes and the lobed portion of the flower buds: 1) *Acutiflorae* K. Schum., with corolla lobes and flower buds acute [with *T. foetida* Poepp. & Endl. and *T. guianensis* K. Schum.]; 2) *Obtusiflorae* K. Schum., with corolla lobes and flower buds obtuse [with *T. formosa* (Cham. & Schltdl.) K. Schum., *T. brasiliensis* Mart., *T. sellowiana* (Cham. & Schltdl.) K. Schum. and *T. bullata* Mart.]. The taxonomic position of the genus has always been clear, as it has been placed in the tribe Gardenieae in all major classifications (Hooker 1873; Schumann 1889, 1891; Bremekamp 1934; Verdcourt 1958; Robbrecht & Puff 1986; Robbrecht 1988, 1993). Persson (1993, 1995, 1996, 2000) with morphological, palynological, and molecular studies confirmed its position in the Gardenieae.

Several floristic and taxonomic treatments are available for the South American species of *Tocoyena*. Schumann (1889) revised the species present in Brazil (and those of contiguous countries) recognizing six species. Steyermark (1965) presented a synopsis of *Tocoyena* for the *Flora of the Guayana Highlands* in which he

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recognized seven species, complemented by important taxonomic information. Taylor and Steyermark (2004) recognized six species present in Venezuela, five of which present in the Venezuelan Guayana.

Prado (1987) revised the species of *Tocoyena* occurring in Brazil, and maintained the two groups published by Schumann. The twelve species recognized in her revision are fully described, beautifully illustrated, with full synonymy, and many specimens cited. She also proposed two varieties for *T. formosa*, based mostly on vegetative characters. However, this study is a master dissertation, and the taxonomic novelties are not effectively published (McNeill et al. 2006: Art. 30.5).

Silberbauer-Gottsberger et al. (1992) revised the group *Obtusiflorae*, which is mostly distributed in the Brazilian Cerrado and Caatinga. The delimitation and synonymy of several species differed significantly from those of Prado. These authors proposed three varieties of *T. formosa*, supported by a multivariate analysis using mostly vegetative characters, resurrected *T. brasiliensis* as a separate species, and presented a key to all the species and varieties recognized in the group *Obtusiflorae*. Two recent floristic treatments of *Tocoyena* are also available from two states of Southern Brazil, Santa Catarina (Delprete et al. 2005) and São Paulo (Prado & Kinoshita 2007), dealing with one and three species, respectively.

The flowers of *Tocoyena* give off a pleasant scent, resembling that of *Gardenia* J. Ellis (Gardenieae), reaching its highest intensity at night, and are pollinated by several species of sphingid moths (Silberbauer-Gottsberger 1972; pers. obs.). Most species of *Tocoyena* have great ornamental potential, and it is surprising that they have not been brought into cultivation for this purpose. In addition, the fruits of all the species of the genus are an important food source for birds (e.g., macaws, parakeets, parrots), mammals (e.g., monkeys, marmosets, tamarins, agoutis, coatis, capybaras, and peccaries) and small marsupials (e.g., opossums) in most Neotropical habitats.

Recently, some collections of *Tocoyena* from white-sand areas in the states of Goiás and Tocantins attracted my attention to the vegetation of these localities. Many studies are available about white sand areas of the Amazon Basin, known in Brazil as “campinas” or “campinaranas,” where they are more evident because of the dramatic difference between their savanic vegetation and the surrounding tall canopy forests typical of the lowland Amazon. Many classic studies on the phytosociology and floristic composition of these Amazonian areas are available, as, for example, those of Ducke (1907, 1913), Ducke & Black (1953, 1954), Gottsberger & Morawetz (1986), Anderson (1981), Prance (1996), Lisboa (1976), and Takeuchi (1960a, 1960b, 1960c, 1961, 1962), among many others. On the other hand, little is known about the vegetation of quartzitic white-sand areas within the Cerrado Biome; this is probably due to the fact that the contrast with the surrounding vegetation is not as striking as that of Amazonian white sands.

The floristic composition of white-sand areas in the Cerrado Biome is still largely unknown, as botanical collections in these areas are sparse and have been made only by botanists randomly passing through these areas. The most important factor influencing species composition in the Cerrado Biome is soil composition, as it has been amply demonstrated by many interdisciplinary studies, as for example those of Cole (1986, 1992), Emmerich (1990), and Haridasan (2001). As a consequence, the vegetation of these areas is made of two main components: 1) plant species also present in the surrounding Cerrado *sensu stricto*, but with smaller individuals than those growing in the surrounding savanna with red soil (pers. obs.), and 2) species of plants (and animals; e.g., Rodrigues et al. 2007) endemic to these areas. The new species of *Tocoyena* described below is certainly one of those narrow endemics. Finally, these white-sand areas are currently in extreme danger of being completely destroyed, as even some ecologists indicated to “encourage the construction of industries and housing in infertile or less fertile soils, as the white sand areas in several region of tabular interfluvium” (liberal translation from Ab’Saber 1990, p. 25), and these areas should be the subject of urgent conservation programs.

SYSTEMATIC TREATMENT

Tocoyena formosa (Cham. & Schltdl.) K. Schum. in Mart., Fl. Bras. 6(6):347. 1889. (**Fig. 1**). *Gardenia formosa* Cham. & Schltdl., Linnaea 4:200. 1829. TYPE: BRAZIL: Southern Brazil, without locality, s.d., Sellow s.n. (HOLOTYPE: B, destroyed, photo-B at NY).



FIG. 1. *Tocoyena formosa* (Cham. & Schtdl.) K. Schum. Individual with basal rosette of leaves sessile to the ground, with subterranean xylopodium (from H.D. Ferreira 3988, NY).

- Tocoyena hirsuta* Moric. ex DC., Prodr. 4:375. 1830. TYPE: BRAZIL: without locality, s.d., *Collector Unknown* s.n. (HOLOTYPE: G-DC).
- Tocoyena velutina* Mart., Flora 24 II, Beibl. 6:81. 1841. TYPE: BRAZIL: MATO GROSSO: Cuiabá, Aug [s.d.] (fl), *Martius* s.n. (HOLOTYPE: M).
- Tocoyena microdon* Mart., Flora 24 II, Beibl. 6:82. 1841. *Tocoyena formosa* (Cham. & Schltdl.) K. Schum. var. *microdon* (Mart.) Gottsb. & Ehrend., Pl. Syst. Evol. 181:163. 1992. TYPE: BRAZIL: MARANHÃO: Rio Itapicurú, 1809 (fl), *Martius* 3297 (HOLOTYPE: M).
- Tocoyena stipulosa* K. Schum., Bot. Jahrb. Syst. 25, Beibl. 60:18. 1898. *Tocoyena stipulacea* K. Schum. ex Glaziov, Mém. Soc. Bot. France 1(3):343. 1909, nom. nud. TYPE: BRAZIL: GOIÁS: Between Macacos and Chico Costa, 9 Oct 1893 (fl), *Glaziov* 21485 (HOLOTYPE: B, destroyed, photo web!; ISOTYPES: BR, C n.v., K n.v. photo web!, R; photo-B at NY).
- Tocoyena mollis* K. Krause, Notizbl. Königl. Bot. Gart. Berlin 6:202. 1915. TYPE: BRAZIL: BAHIA: Remanso, catinga, Dec 1906 (fl), *Ule* 7143 (HOLOTYPE: B, destroyed, photo web!, ISOTYPE: L n.v.; photo-B at F, NY).
- Tocoyena surinamensis* Bremek., Rec. Trav. Bot. Neerl. 33:710. 1936. TYPE: SURINAME: upper Sipaliwini River, savanna near Platte Berge, 5 Dec 1935 (fl), *H.E. Rombouts* 323 (HOLOTYPE: U; ISOTYPES: C n.v., K n.v. photo web!, MO, U, US).
- Tocoyena formosa* (Cham. & Schltdl.) K. Schum. var. *pseudobrasiliensis* Gottsb. & Ehrend., Pl. Syst. Evol. 181:162. 1992. TYPE: BRAZIL: SÃO PAULO: Mun. Botucatu, 18 km N, 14 km E of São Manuel-Piracicaba highway, near ex-railway station Treze de Maio, 22°45'S, 48°25'W, 550 m, 1 Nov 1971, *I. Gottsberger & G. Gottsberger* 11-11171 (HOLOTYPE: UB; ISOTYPES: BOTU, K n.v. photo web!, GI n.v., NY).

Taxonomic observations: Silberbauer-Gottsberger et al. (1992) recognized three widely sympatric varieties in *Tocoyena formosa*, according to the results of a multivariate analysis using vegetative characters and field observations in patches of Cerrado in the state of São Paulo (Southern Brazil). However, a study of about 900 herbarium specimens and personal field observations of this species throughout its range demonstrated that the leaves vary widely in shape and vestiture, ranging from densely pubescent to tomentose (or exceptionally glabrous and minutely bullate) within the same populations throughout Brazil, but the floral characters remain constant throughout its geographic distribution. For the above reasons, *T. formosa* is here treated as a plastic species with polymorphic vegetative characters, with the same delimitation proposed by Silberbauer-Gottsberger et al. (1992), but without any subspecific taxonomic ranks recognized.

In the southern portion of the state of Goiás, and more specifically in the Parque Nacional das Emas and the Serra dos Caiapós, several collections were made of individuals reduced to a basal rosette of leaves, practically sessile to the ground or with an aerial stem of up to 3–5 cm long, and a xylopodium trailing horizontally underground up to 70 cm in length (or maybe longer, as they were broken off by the collectors). Aside from the extremely reduced habit, the leaves, flowers and fruits of these individuals are practically identical to those with shrubby or arboreal habit (Figure 1). Because of this, these individuals are treated here as a sessile form of *T. formosa* without any taxonomic recognition. The reason for this peculiar habit is unknown, but, because all these individuals were collected in shrubby campos (“campos sujos”) on sandy/rocky soils, it is probable that the depauperate soil low in nutrients and the frequent fires influenced their subterranean habit. The collections examined with sessile leaf rosettes are listed here: BRAZIL: GOIÁS: Mun. Mineiros, Parque Nacional das Emas, 11 Oct 1994 (fl), *H.D. Ferreira* 2744 (NY, UFG), 12 Nov 1998 (fl), *H.D. Ferreira* 3608 (UFG), 26 Feb 1995 (fr), *H.D. Ferreira & O. Silva* 3452 (NY, UFG), 11 Oct 1994 (fl), *H.D. Ferreira* 3900 (UFG), 12 Nov 1998 (fl), *H.D. Ferreira* 3988 (NY, UFG); Serra do Caiapó, ca 60 km S of Caiapônia, on road to Jataí, 27 Oct 1964 (fl), *Irwin & Soderstrom* 7425 (NY, RB).

Distribution and ecology.—Widely distributed in tropical South America, from Suriname and throughout Brazil and Paraguay. Subshrub, shrub or tree (exceptionally reduced to a sessile rosette with a subterranean xylopodium; Figure 1); highly plastic and adapted to a wide variety of habitats. One of the most representative species of Neotropical savannas (Brazilian Cerrado), mostly in shrubby savannas (“Cerrado sensu stricto”), but also encountered at gallery forest margins, in mesophytic forests (“Cerradão” of Brazil), shrubby campos (“campos sujos”), and on rocky outcrops (“campos rupestres”). Sometimes also found in disturbed vegetation or even as a pioneer species in secondary vegetation in the Cerrado Biome.

Selected specimens examined: BRAZIL: BAHIA: Mun. São Desidério, dirt road between Roda Velha and Estiva, 725 m, 12°42'S, 45°48'W, 7 Nov 1997 (fl), *D. Alvarenga et al.* 1024 (NY); Mun. Formosa do Rio Preto, Projeto Ouro Verde, Rod. Anel de Soja, 710 m, 11°26'S, 46°4'W, 14 Nov 1995 (fl), *B.M.T. Walter et al.* 2927 (CEN, NY). TOCANTINS: Mun. Porto Nacional, 10 Oct 1993 (fl), *M. Alves* s.n. (HTO, NY); Mun. Pium, Ilha do bananal, Parque Nacional do Araguaia, Rio Javaés, 9°59'S, 50°7'W, 27 Mar 1999 (fr), *M.A. Alves et al.* 4192 (IBGE); Mun. Dianópolis, 570 m, 11°40'S, 46°40'W, 30 Sep 2003 (fl), *T.B. Cavalcanti et al.* 3385 (CEN); Mun. Porto Nacional, Área da FAB, 7 Aug 1993 (fl), *J. Ferreira et al.* 4 (HTO); Mun. Araguaína, ca 10 km S of Araguaína, 300 m, 16 Mar 1968 (fr), *Irwin et al.* 21237 (NY); Mun. Palmas, Serra do Lageado, between Rio Taquarassu and Rio Taquarassusinho, 48°13'S, 10°17'W, 13 Apr 1994 (fr), *I.V. Lima & F.P.R. de Jesus* 274

(HEPH, HTO), 275 (HEPH); Mun. Tupiratins, Córrego Almoço, 8°14'S, 48°9'W, 27 Oct 2000 (fl), S.F. Lolis *et al.* 71 (HTO); Mun. Caseara, Parque Estadual do Cantão, 22 Jan 2000 (imm fr), P.E. Nogueira & M. Richter 752 (IBGE, NY); road Taguatinga-Aurora do Norte, km 9, 6 Dec 1991 (fl), B.A.S. Pereira *et al.* 2005 (IBGE, NY); Mun. Presidente Kennedy, road from BR-153 to Itaporã, 12 km W of Presidente Kennedy, Faz. Primavera, along Ribeirão Feíinho, ca 3°25'S, 48°37'W, 400–500 m, 1 Feb 1980 (fr), Plowman *et al.* 8259 (NY, UB); Transamazônica, junction of Nazaré, 10 Sep 1973 (fl), Rizzo 9273 (NY, UB, UFG). **GOIÁS:** Mun. Niquelândia, dirt road 27 km from Colinas do Sul, near Rio Tocantinzinho, 14°11'S, 48°6'W, 480 m, 6 May 1998 (imm fr), D. Alvarenga *et al.* 1164 (IBGE, NY); Mun. Nova Roma, road towards Iaciara, Faz. Santa Clara, 485 m, 13°45'S, 46°51'W, 29 Feb 2000 (fr), D. Alvarenga *et al.* 1286 (CEN, IBGE, NY); Chapada dos Veadeiros, 13 km by rd S of Terezina, ca 1,000 m, 16 Mar 1973 (fr), Anderson *et al.* 7254 (NY, UB); Serra Geral do Paraná, 7 km by rd of São João da Aliança, 1,100 m, 22 Mar 1973 (fr), Anderson *et al.* 7677 (NY, UB); Mun. São Domingos, near Água Quente, Faz. São Domingo, 13°37'S, 46°44'W, 27 Oct 2000 (fl), M.A. da Silva *et al.* 4558 (IBGE, NY); Mun. Campinaçu, Córrego Laginha, 13°47'S, 48°14'W, 495 m, 9 Oct 1991 (fl), T.B. Cavalcanti *et al.* 901 (CEN, NY); Mun. Alto Paraíso, São Jorge, dirt road to Vale da Lua, 14°10'S, 47°46'W, 870 m, 19 Sep 1998 (fl), Delprete *et al.* 6703 (BR, CAY, GB, HTO, NY, RB, UB, UFG); Mun. Alto Paraíso, Parque Nacional Chapada dos Veadeiros, Faz. Murungú, 23 Sep 1998 (fl), Delprete *et al.* 6772 (BR, GB, HTO, NY, UB, UFG); Mun. Mineiros, Parque Nacional das Emas, road from Água Ruim to Furna Grande, 18°8'S, 52°44'W, 680 m, 5 Oct 1998 (st), Delprete *et al.* 6817 (K, MO, NY, UB, UFG); Mun. Caiapônia, Serra dos Caiapós, road Caiapônia-Montevidiu, 5–20 km de Caiapônia, 17°5'S, 51°44'W, 680–700 m, 12 Oct 1998 (fl, imm fr), Delprete *et al.* 6828 (GB, K, NY, NX, UB, UFG); Mun. Pirenópolis, Parque Estadual da Serra dos Pireneus, base do Morro do Cabeludo, 15°48'S, 48°49'W, 1280 m, 26 Nov 2005 (fl), Delprete *et al.* 9323 (RB, UFG); Mun. Pirenópolis, Fazenda Quebra Rabicho, Córrego das Contenas, 15°44'S, 49°2'W, 8 Jul 2006 (fr), Delprete *et al.* 9850 (NY, UFG); Mun. Mossâmedes, Serra Dourada, Reserva Biológica J.A. Rizzo, near housing, 26 Oct 1997 (fl), Gomes-Klein *et al.* 3308 (NY[2], UFG), 3320 (NY, UFG); Serra dos Cristais, 17°S, 48°W, ca 2 km N of Cristalina, 1,250 m, 5 Nov 1965 (fl), Irwin *et al.* 9905 (NY, UB); Serra do Rio Preto, 16°S, 47°W, ca 3 km E of Cabeceiras, 1,000 m, 19 Nov 1965 (fr), Irwin *et al.* 10566 (NY, UB); Mun. Pirenópolis, Serra dos Pireneus, 16°S, 49°W, Dec 1965 (fl), Irwin *et al.* 10869 (MO, NY, RB, UB); Serra dos Cristais, 17°S, 48°W, 10 km W of Cristalina, 1,200 m, 4 Mar 1966 (fr), Irwin *et al.* 13448 (NY, UB); Serra Geral de Goiás, 14°S, 46°W, Rio da Prata, 6 km S of Posse, 800 m, 6 Apr 1966 (fr), Irwin *et al.* 14419 (NY, UB); Mun. Monte Alegre, Faz. Nica, 530 m, 13°8'S, 46°39'W, 30 Oct 2000 (fr), F.C.A. Oliveira *et al.* 1159 (CEN, IBGE, NY); Mun. Goiânia, rod. Goiânia-Guapó, Córrego Pindaíba, 3 Sep 1968 (fl), Rizzo & Barbosa 2075 (NY, UFG); Mun. Brazlândia, Fazenda Alegre, 2 Oct 1990 (fl), A.H. Salles 1758 (HEPH, IBGE, NY). **DISTRITO FEDERAL:** Reserva Ecológica do IBGE, área da RECOR, 26 Sep 1977 (fl), Heringer *et al.* 122 (IBGE), 23 Oct 1978 (fl), 681 (IBGE), 11 Oct 1982 (fl), 7525 (IBGE, UB); ca 5 km NE de Planaltina, on rd to São Gabriel de Goiás, 1,200 m, 16 Oct 1965 (fl), Irwin *et al.* 9248 (NY); confluence of Riberão Bananal with Lagôa Paranoá, 975 m, 13 Jan 1966 (fr), Irwin *et al.* 11627 (NY, UB); perto do Riberão Sobradinho, 15°44'S, 47°44'W, 1,000 m, 28 Sep 1981 (fl), Kirkbride 4467 (NY, UB); Faz. Vale Verde, perto do Córrego Açude, 15°39'S, 47°28'W, 1050 m, 26 Aug 1981 (fl), Kirkbride 4515 (NY, UB); Fazenda Água Limpa, Campo Experimental da UnB, 15°58'S, 47°55'W, 26 Sep 1983 (fl), Kirkbride & L.V. Ferreira 5397 (NY); Brasília, Parque Ecológico Norte Burle Marx, 23 Oct 2003 (fl), J.R. Santos & G.A. Moreira 120 (CEN). **MINAS GERAIS:** Mun. Paraopeba, 30 Nov 1965 (fl), R. Goodland 251 (NY); ca 25 km W of Montes Claros, road to Água Boa, 1,000 m, 23 Feb 1969 (fr), Irwin *et al.* 23719 (NY); Mun. Patrocínio, ca 4 km N of Patrocínio, 1,000 m, 31 Jan 1970 (fr), Irwin *et al.* 25735 (NY); Mun. Formoso, Parque Nacional Grande Sertão Vereda, Fazenda Mato Grande, Córrego Mato Grande, near waterfall, 770 m, 15°19'S, 45°59'W, 18 Oct 1997 (fl), R.C. Mendonça *et al.* 3200 (IBGE, NY); Mun. Corinto, Fazenda do Diamante, base of Serra do Anjico, 600 m, 15 Apr 1931 (fr), Y. Mexias 5630 (NY); Estrada Três Marias a Corinto, km 62, beira de cerradão, 30 Nov 1976 (fl), G.J. Shepherd *et al.* 3827 (NY). **SÃO PAULO:** Mun. Botucatu, 18 km N, 14 km E of São Manuel-Piracicaba highway, near ex-railway station Treze de Maio, 22°45'S, 48°25'W, 550 m, I. Gottsberger & G. Gottsberger 2222-1 (BOTU n.v., GI n.v., NY, UB).

Tocoyena brasiliensis Mart., Flora 24 II, Beibl. 6:82. 1841. TYPE: BRAZIL: RIO DE JANEIRO: "Monte Telegraphi prope Sebastianopolin," June [s.d.], Luschnath in Martius Herb. Fl. Brasil. s.n. (HOLOTYPE: BR).

Taxonomic observations.—*Tocoyena brasiliensis* was treated as synonymous to *T. sellowiana* (Cham. & Schltldl.) K. Schum. by Prado (1987). Silberbauer-Gottsberger *et al.* (1992) treated it as a distinct species because of the "corolla tube entrance villous; leaves obovate, 15–17 × 6–7.5 cm (vs. "corolla tube entrance glabrous; leaves oblong-lanceolate, smaller, mostly 7–9 × 2.5–3.5 cm" in *T. sellowiana*). Delprete (2005) also treated *T. sellowiana* as a distinct species, occurring from Bahia to Rio de Janeiro and Santa Catarina. Prado and Kinoshita (2007) treated them as distinct species, but also wrote that further studies might demonstrate that in fact they are synonymous.

Tocoyena brasiliensis is also similar to *T. formosa*, from which it is easily distinguished by the leaf blades completely glabrous or rarely with puberulent secondary veins below and plane (vs. variously pubescent or rarely glabrous and microscopically bullate) and for the vegetative and reproductive parts turning brownish-black when dry (vs. turning olive green to brown when dry).

Distribution and ecology.—Widely distributed in Brazil, from Amapá, Pará, Maranhão, Pernambuco, Bahia, Mato Grosso, Tocantins, Goiás, Minas Gerais to São Paulo. Shrub or small tree encountered in gallery

forests sometimes seasonally inundated, and less frequently in mesophytic forests, shrubby savanna and rocky outcrops with superficial water table.

Selected specimens examined: **BRAZIL: TOCANTINS:** Mun. Couto-Magalhães, road Couto Magalhães-Colinas de Tocantins, 5 km from Couto Magalhães, 8°19'29"S, 49°9'25"W, 200 m, 4 Nov 2005 (fl), *Delprete et al.* 9266 (CAY, HPL, HTO, NY, UFG); Mun. Goiatins, Aldeia Rio Vermelho, 230 m, 8°2'S, 47°15'W, 16 Apr 2001 (fr), *E.S.G. Guarino & J.P. Krahô* 750 (CEN); 10 km S of Araguaína, 300 m, 16 Mar 1968 (fr), *Irwin et al.* 21237 (NY, UB); Mun. Lajeado, Faz. Ribeirão dos Mares, Rio Tocantins, 0788531, 8915570 UTM, 22 Oct 1999 (fl), *S.F. Lolis et al.* 318 (HTO); Mun. Porto Nacional, 10 km from Posto do Trevo, 18 Nov 1997 (fl), *L. Silva et al.* s.n. (HTO, UFG); Mun. Miracema do Norte [now Miracema do Tocantins], Aldeia dos Índios Xerente, 20 km from Miracema do Norte, 200 m, 9°53'S, 48°36'W, 11 Apr 1988 (st), *L.A. Skorupa & J.N. Silveira* 431 (CEN); Mun. Palmas, Rio Tocantins, 9°59'39"S, 48°20'49"W, 9 Oct 2000 (fl), *E.A. Soares et al.* 1013 (HTO); Mun. Lajeado, road Palmas-Lajeado, 9°57'S, 48°20'W, 10 Oct 2001 (fl), *E.A. Soares et al.* 1623 (HTO); Mun. Brejinho de Nazaré, Faz. Santa Angelina, Reserva 1, 11°6'47"S, 48°41'20"W, 5 Nov 2001 (fl), *E.A. Soares et al.* 1696 (HTO). **GOIÁS:** Mun. Niquelândia, Faz. Limoeiro, 420 m, 25 Nov 1992 (fl), *S.P. Cordovil et al.* 172 (CEN); Mun. Mineiros, Parque Nacional das Emas, Rio Jacuba, 17°54'S, 52°52'W, 790 m, 2 Oct 1998 (fl), *Delprete et al.* 6802 (GB, K, NY, RB, UB, UFG); Mun. Mineiros, Parque Nacional das Emas, área 3, 21 Oct 1989 (fl), *H.D. Ferreira* 2093 (NY, UFG); Serra dos Pireneus, 16°S, 49°W, ca 12 km S of Corumbá de Goiás, 1,000 m, 1 Dec 1965 (fl), *Irwin et al.* 10869 (NY, UB); Mun. Alvorada do Norte, Fazenda Largomar, 550 m, 14°31'S, 46°34'W, 28 Nov 2003 (fl), *A.C. Sevilha et al.* 3616 (CEN); Mun. Serranópolis, RPPN Pousada das Araras, 51°59'W, 18°26'S, 560 m, 25 Oct 2005 (fl), *L.F. Souza et al.* 1232 (UFG); Mun. Caldas Novas, Alternativa 9, margin of Rio Corumbá, 17°42'S, 48°32'W, 720 m, 27 Oct 1993 (fl), *R.F. Vieira et al.* 1740 (CEN). **DISTRITO FEDERAL:** Campus of the Universidade de Brasília, 14 Nov 1978 (fl), *Heringer* 17172 (IBGE, UB); just outside of Reserva Biológica Águas Emendadas, 3 Sep 1995 (fl), *C. Proença et al.* 1500 (UB). **MATO GROSSO:** Mun. Santa Terezina, Faz. Codeara, Serra da Viúva, 12 km S of Santa Terezina, 10°40'S, 50°35'W, 10 Oct 1985 (fl), *C.A. Cid Ferreira et al.* 6404 (NY); Mun. Brilhante, Fazenda Progresso, 28 Oct 1970 (fl), *Hatschbach* 25286 (NY). **MATO GROSSO DO SUL:** Mun. Três Lagoas, Fazenda Dr. José Mendes, 12°30'S, 40°29'W, 20 Oct 1964 (fl), *J.C. Gomes* 2369 (NY).

Tocoyena viscidula Mart., *Flora* 24 II, Beibl. 6:80. 1841. TYPE: BRAZIL: BAHIA: "in silvis Caatinga mediterraneis," s.d., *Martius* s.n. (HOLOTYPE: M n.v.; photo-M at UEC n.v., UFMT).

Taxonomic observations.—Schumann (1889) treated *Tocoyena viscidula* Mart. as a synonym of *T. formosa*, without any additional comments. Prado (1987) and Silberbauer-Gottsberger et al. (1992) recognized this species as rare and distinct, mostly because of observations made on 20th century collections. Accordingly, it is treated here as a distinct species, easily recognizable by its leaf blades densely lanate on both sides.

Distribution and ecology.—A species mostly collected in the State of Goiás and the Distrito Federal, with just a few collections known from the states of Bahia (where the type is from) and Piauí. A small shrub 10–70(–200) cm tall, encountered only in shrubby fields ("campos sujos") and rocky outcrops ("campos rupestres") within the Caatinga and Cerrado Biomes.

Conservation.—A rare species that needs to be added to the category of critically endangered taxa, as the last collections known were made in 1980–81. The habitats of this species are in need of an urgent conservation program.

Phenology.—Flowering specimens were collected during the rainy season, from August to November, and the only fruiting collecting known was made in February.

Specimens examined: **BRAZIL: GOIÁS:** Mun. Cristalina, Serra dos Cristais, 7 Oct 1981 (fl), *Hatschbach* 44060 (MBM, UB); Mun. São João da Aliança, 21 km from Nossa Senhora de São Gabriel de Goiás, 1,000 m, 14 Oct 1980 (fl), *G. Martinelli et al.* 7485 (UB). **DISTRITO FEDERAL:** Fazenda Água Limpa, Campus da UnB, 47°56'S, 15°57'W, 16 Oct 1979 (fl), *César* 638 (UB); Brasília, TV Record, 23 Oct 1978 (fl), *Heringer et al.* 681 (UB); Brasília, Saia Velha, R-1, 10 Feb 1961 (fr), *Heringer* 8135/329 (UB); Brasília, D.N.E.R., 10 Oct 1962 (fl), *Heringer* 9046 (NY, UB); Brasília, Saia Velha, 22 Nov 1964 (fl), *Heringer* 9964 (NY, RB, UB); Brasília, Catetinho, 15 Nov 1973 (fl), *Heringer* 13005 (UB); Fazenda Água Limpa, Campus da UnB, Vargem Bonita, ca 18 km from Brasília TV tower, 8 Oct 1976 (fl), *Ratter et al.* 3736 (UB).

Tocoyena arenicola Delprete, sp. nov. (**Fig. 2**). TYPE: BRAZIL: TOCANTINS: Mun. Miracema do Tocantins, road towards Lajeado (TO-070), 3 km from Miracema do Tocantins, cerrado vegetation on white sand, 9°35'13"S, 48°24'32"W, 230 m, 3 Nov 2005 (fl, fr), *P.G. Delprete, H. Lorenzi, J.A. Lombardi & E.G. Gonçalves* 9249 (HOLOTYPE: UFG; ISOTYPES: CAY, HPL, MO, NY, RB, UB).

Tocoyena formosae similis sed differt statura suffruticis 0.3–1 m altae caulibus 5–15 e xylopodio emergentibus (nec statura fruticis vel arboris usque ad 10 m (vel paulo ultra) altae vulgo trunco ad 20 cm crasso suffultae, vel raro solummodo in rosulam basalem e xylopodio horizontale ortam evoluta), praeterea corollis 3.6–6.5 cm longis (nec 8.5–14 cm longis) et laminis foliorum minoribus bene distincta.

Subshrubs to small shrubs 0.3–1 m tall, with 5–15 stems originating from a single xylopodium; stems simple or few-branched, terete or slightly laterally compressed, erect-pubescent to tomentose; bark papyraceous,



FIG. 2. Holotype of *Tocoyena arenicola* Delprete. A. Branch with flower buds and flowers in anthesis. B. Detail of a branch with a mature fruit (from P.G. Delprete et al. 9249, UFG).

pale brown to reddish-brown. **Stipules** narrowly triangular, oblong-triangular to lanceolate, 6–12 × 3–4 mm, acute to acuminate, glabrous or sparsely-pubescent outside, margins glabrous or ciliate, covered with coleters at basal portion and glabrous distally inside, persistent. **Leaves** sessile to short-petiolate; petioles 2–10 mm long, canaliculate, densely pubescent; blades elliptic, oblong-elliptic to obovate, 1.5–6.5(–10.5) × 0.5–3(–5.5) cm, acute at base, obtuse to acute at apex, papyraceous to subcoriaceous, plane or micro-bullate, sparsely to densely pubescent above, tomentose-pubescent below, olive green to dark brown above and olive green below when dry; with 8–11 secondary veins each side. **Inflorescences** condensed-cymose, 3–11-florous; sessile to short-pedunculate, peduncles to 10 mm long; rachis antrorse-pubescent, hairs pale brown; secondary branchlets 1–7 mm long; bracts deltoid to narrowly triangular, 0.5–3 mm long, glabrous or sparsely pubescent, persistent. **Flower buds** pale green, lobed portion obtuse. **Flowers** sessile (terminal ones) or subsessile (lateral ones). Hypanthium turbinate, 3.5–4.5 mm long, glabrous or sparsely pubescent. Calyx cupular or short-tubular, 3–5 mm long, 5-lobed, glabrous or sparsely pubescent outside, with a few coleters among the teeth inside; lobes triangular to lanceolate, 1.5–3.5 mm long, ciliate. Corolla hypocrateriform, 3.6–6.5 cm long, white or cream-white, turning yellow at final stage of anthesis, hirtellous to erect-pubescent outside, glabrous inside, dark brown when dry; tube narrowly cylindrical, 3–6 cm long, slightly ampliate near the mouth; lobes elliptic to oblong-ovate, 6–10 × 8–9 mm, slightly asymmetrical, obtuse, punctulate inside, margins ciliate. Stamens sessile to subsessile; anthers oblong, 4–5 mm long, shortly-apiculate, base bilobed. Style exerted, 3.5–6.5 cm long, thickened-clavate distally, glabrous; style branches narrowly obovate, 4–4.5 mm long, dorsally tricostate. **Fruit** globose or subglobose, 1.8–2 cm in diam, smooth (not ribbed), green and puberulent when young, yellow and glabrescent when ripe, turning black when dry.

Taxonomic observations.—*Tocoyena arenicola* Delprete is similar to *T. viscidula* in being a subshrub with a basal xylopodium, from which it is easily distinguishable by the characters given in the key (see below). However, because of the vestiture of the vegetative and reproductive parts it is most similar to *T. formosa* with which it has sometimes been confused. *Tocoyena arenicola* differs from *T. formosa* because it is a subshrub to small shrub 0.3–1 m tall, with 5–15 stems originating from a single xylopodium (vs. shrub or treelet to tree (0.5–)3–10(–12) m tall, commonly with a main trunk up to 20 cm dbh or exceptionally reduced to a single basal rosette of leaves and a horizontal xylopodium), with corollas 3.6–6.5 cm long (vs. 8.5–14 cm long), and leaf blades 1.5–6.5(–10.5) × 0.5–3(–5.5) cm (vs. (7–)9–20(–24) × (5–)8–15 cm).

Distribution and ecology.—A species known from a few collections in the extreme north of the state of Goiás (Mun. Posse) and the central-southern region of the state of Tocantins (Mun. Dianópolis and Miracema do Tocantins). Subshrub to small shrub, heliophilous, with a short basal xylopodium, and found only in shrubby fields (“campos sujos”) on quartzitic white sands within the Cerrado Biome, sometimes in association with *Melocactus* spp. (Cactaceae) and *Syagrus acaulis* (Drude ex Mart.) Becc. (Palmae). The vegetation present in these white-sand areas contains species also common in the Cerrado Biome, but stunted and much smaller than when growing in the surrounding savanna with regular red soil (pers. obs.). In addition, it also contains a suite of species endemic to these areas, and *Tocoyena arenicola* is one of those.

Conservation.—Known by just a few collections, it is a rare species that must be placed in the category of imminent threat of extinction. This is supported by the fact that white-sand areas in the Cerrado Biome are primarily utilized for the construction of houses and buildings, as they are not suitable for agriculture and cattle ranching. In general, these areas should be urgently conserved, as they support many rare and endangered species of plants and animals.

Phenology.—Flowering and fruiting collections were realized from September to November.

Additional specimens examined: **BRAZIL: Goiás:** Mun. Posse, Nova Vista, campo cerrado, 8 Oct 1976 (fl), *Hatschbach* 39048 (MBM, NY); Mun. Posse, dirt road to airport, cerrado recently burned, sandy soil, 820 m, 14°6'S, 46°20'W, 16 Oct 2001 (fl), *R.C. Mendonça et al.* 4450 (CEN, IBGE); Mun. Posse, road between Guarani and Posse, sandy soil, 830 m, 14°57'S, 46°22'W, 19 Oct 2001 (fl), *R.C. Mendonça et al.* 4508 (CEN, IBGE). **Tocantins:** Mun. Dianópolis, open cerrado on quartzitic sand, 660 m, 11°37'S, 46°26'W, 28 Sep 2003 (fl), *T.B. Cavalcanti et al.* 3233 (CEN); Mun. Miracema do Tocantins, road towards Lajeado (TO-070), 3 km from Miracema do Tocantins, cerrado

on white sand, 9°35'13"S, 48°24'32"W, 230 m, 3 Nov 2005 (fl, fr), *Delprete et al.* 9252 (CAY, HTO, NY, SP, UFG); Mun. Dianópolis, area with quartzitic sand, 720 m, 11°36'S, 46°28'W, 25 Sep 2003 (fl), *A.O. Scariot et al.* 759 (CEN).

KEY TO THE NATIVE SPECIES OF *TOCOYENA*
IN THE STATES OF GOIÁS AND TOCANTINS, BRAZIL

1. Subshrub to small shrub 0.1–1(–2) m tall, with 3–15 stems originating from a basal xylopodium.
 2. Leaf blades 7–17 × 6–11 cm, densely lanate on both sides; corollas 10–12.5 cm long (tube 8.5–11 cm long), hirsute-pubescent (shrubby fields and rocky outcrops) _____ **T. viscidula**
 2. Leaf blades 1.5–7 × 0.7–3 cm, adpressed-pubescent above, sparsely lanate below; corollas 3.6–6.5 cm long (tube 3–6 cm long), hirtellous (shrubby fields on quartzitic white-sand) _____ **T. arenicola**
1. Shrub, treelet to tree (0.5–)3–10(–12) m tall, commonly with a main trunk up to 20 cm dbh (exceptionally individuals reduced to a basal rosette of leaves and with a horizontal xylopodium in *T. formosa*, in open fields in the Parque Nacional das Emas and in the Serra dos Caiapós).
 3. Leaf blades chartaceous to papyraceous, plane, completely glabrous or rarely with puberulent veins below, dark brown to black when dry; corollas glabrous externally _____ **T. brasiliensis**
 3. Leaf blades papyraceous to coriaceous, plane or minutely bullate, pubescent, velutinous-tomentose, hispid or rarely glabrous above, pubescent, velutinous-tomentose or rarely glabrous below, grayish, olive green to pale brown when dry; corollas tomentose, puberulent or glabrescent externally _____ **T. formosa**

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